Revue suisse Zool.	Tome 81	Fasc. 1	p. 13-24	Genève, avril 1974

Endoparasites of Roe Deer *(Capreolus capreolus* L.) from Switzerland with special reference to hosts from the Emmental region of Canton Berne

by

J. R. H. ANDREWS, B. HÖRNING, and A. WANDELER

The roe deer *(Capreolus capreolus capreolus)* is widely distributed in Europe and Asia and has been the subject of extensive parasitological investigations in a number of countries within these two regions. A by no means exhaustive list of such work would include: Hübner, 1938 (Germany); Kreis, 1952 (Switzerland); Asadov, 1954, 1960 (U.S.S.R.); Jansen, 1958 (Holland); Kotrlý, 1964 (Czechoslovakia); Delić, Levi and Rukavina, 1965 (Yugoslavia); Dunn, 1965 (England); Dróżdż, 1966 (Poland); Kutzer and Hinaidy, 1969 (Austria); and Nilsson, 1971 (Sweden). A good recent summary of helminth records from roe deer, and the associated literature, is given by Nilsson (1971).

The roe deer is also present in Switzerland where it is common and widespread and subject to fairly stringent hunting laws that vary from Canton to Canton. Although the health of these animals is the subject of general concern, there has been less detailed research into roe deer parasitology here than in a number of other European countries. A large part of the published work in Switzerland has eminated from the diagnostic reports of veterinarians, or has been part of wide-ranging parasitological surveys covering a variety of hosts. A summary of helminthological records made from roe in this country, and the literature, is given in Table I.

One of the objects of this study was to take a closer look at the helminths infecting Swiss roe deer, with particular attention being paid to those nematodes found in the abomasum and the small intestine. In some of the previous works many of the worms from these organs were identified only to genus level or were recorded simply as "gastro-intestinal nematodes". The absence of detailed work in this area is further suggested by the fact that only about one-quarter of the known parasites of the abomasum and small intestine of roe (as listed in Nilsson, 1971) have been recorded from Swiss roe deer. Work from other areas in Europe suggests that a large number of these parasites (which are mostly trichostrongylids) are in fact fairly widely distributed and could reasonably be expected to occur in Switzerland.

Although the number of hosts available for this study was expected to be small (owing to local hunting regulations) it was hoped that enough material would be available to give some idea of prevailing worm population levels and incidence of infection by the various species.

Another of the objects of this study was to use this material for the examination of the distribution of parasites within the host. The results from this part of the work will be published elsewhere.

MATERIALS AND METHODS

Fifteen roe deer shot on two hunting expeditions near Ramisberg and Huttwil in the Emmental region, Canton Berne, were completely eviscerated. The lungs, alimentary tract and infected livers were kept for parasitological study; the adrenals, gonads and the jawbones were taken as material for a population study by one of the authors. The carcases, kidneys and uninfected livers were retained by the hunters. The rumen was examined in the field. The material was collected on the 24.10.70 and 31.10.70. Seven of the animals were young of the year (i.e. approximately six months old), the remainder were adults.

In the laboratory, standard practice for the examination of organs for parasites was followed. The bronchi of the lungs were slit and examined for worms. The lower tips of the lung lobes were cut off and the cut face squeezed firmly onto a glass slide and the resulting blood and mucous was then examined for worm larvae. The alimentary canal was carefully unravelled and divided into small sections, the contents of which were washed into a fine sieve, cleaned in running water and examined under a binocular microscope. Worms were picked out from the plant debris and placed in numbered phials. They were then identified under a compound microscope and counted. Female Ostertagiea from the abomasum are difficult to separate morphologically (at the species level) and so were counted together. Males of species in this tribe have better diagnostic features and were able to be counted. The bile ducts of suspect livers were opened and searched for flukes. Histological preparations were made of infected liver and those parts of the alimentary tract that appeared, on gross examination, to have undergone some change as a result of parasitic infection. Large worms that needed to be cleared for identification were processed in increasing concentrations of glycerine.

The study was broadened by the availability of the previously unpublished diagnostic records of the Parasitology Department of the Veterinary Bacteriology Institute, University of Berne. Records from 405 hosts, all from Canton Berne, were available for analysis. These were from both sick and healthy hosts examined throughout the year. In each case the viscera were examined in their entirety, but worm counts were not made, infections being classified simply as "heavy", "medium" or "light".

RESULTS

Twenty-one species of helminth parasites were recorded from the Emmental deer, as shown in Table II below. Of these, 6 species are new records from roe deer in Switzerland and a further 2 are confirmations of records made previously only from egg identifications. All fifteen hosts were infected, the number of species per host ranging from 5 to 14 with a mean of 11. From 3 to 9 species per host were found from the abomasum—the most fruitful source of specimens. Up to 4 species per host were found from the small intestine; 1 species from the caecum; and 2 from each of the large intestine, lungs and liver. The mesenteries yielded one species.

The most common species, both from the point of view of numbers present and the frequency of infected hosts were: *O. leptospicularis*, *S. spiculoptera* and *T. axei* from the abomasum; *T. capricola* and *N. filicollis* from the small intestine; *T. ovis* from the caecum; *C. ovina* from the large intestine and *D. viviparus* from the lungs. The proportions of the species (relative to each other) in the various organs are given in Table III. Figures giving the mean totals and ranges of total worm population in each organ are given in Table IV.

The records of *F. hepatica* were made from livers that showed raised altered areas about 2 cm in diameter. Histological examination revealed small clusters of young flukes. The tissues of the abomasum, small intestine and caecum showed very little gross evidence of parasite infection. Large intestines that had fairly heavy infections of *C. ovina* showed, in gross view, scattered pinkish patches (presumably feeding sites) deposits of mucous, and nodules on the mucosal surface. Histological sections showed, however, that there was no serious tissue damage or alteration. In only two cases was there gross evidence of minor lung damage from *D. viviparus* infections. The presence of *Capreocaulus capreoli* could be detected in gross view by the presence of distinct nodes on the lower border of the major lobes of the lungs.

The host sample split fairly evenly into two age groups—one of about 6 months of age and the other of animals over 1.5 years of age. Relating host age to *D. viviparus* infection shows a distinct preference by this species for hosts in the younger age group where 6 out of 7 animals were infected. In the older group only 1 of 8 animals were infected. No such clear cut preferences were exhibited by any other of the helminth species found in this group of hosts, nor did there appear to be any difference in total worm population numbers between the two groups.

The diagnostic records of the Veterinary Bacteriology and Parasitology Institute name the following genera and species from roe deer (figures for the incidence of infection are given in brackets): *Ostertagia* spp. (24.2%), *Trichostrongylus* spp. (10.8%), *Nematodirus filicollis* (10.4%), *Trichuris ovis* (37.3%), *Haemonchus* sp. (29.6%), *Marshallagia* sp. (1.15%), *Chabertia ovina* (61.5%), *Dictyocaulus viviparus* (36.5%), *Capreocaulus capreoli* (39.4%), *Setaria tundra capreoli* (3.1%), *Dicrocoelium lanceolatum* (12.7%), *Moniezia expansa* (4.2%), *Eimeria* spp. (10.4%).

The above figures for incidence of infection do not take into calculation the 90 animals examined that were under 3 months of age (i.e. in their first summer). Only 6 of these animals had any parasitic infection. The record of *Marshallagia* sp. is a new one for roe deer from Switzerland. As shown in Table V, some of the species recorded were found more frequently in hosts classified as "sick" and the lungworms (*D. viviparus* and *C. capreoli*) and *T. ovis* showed a greater incidence of infection in young animals.

DISCUSSION

Except where otherwise indicated, the following discussion is of the results from the 15 Emmental deer examined. It was somewhat surprising to find that the most frequently recorded species were among those that had not been previously identified in Switzerland—*O. leptospicularis* and *T. capricola* in particular can be mentioned. This may reflect the fact that more recent surveys (Kreis, 1952, 1962) have relied heavily on eggs and larvae from faecal material, thus limiting the number of accurate identifications at the species level, and earlier works tended to cover the parasites and diseases of a broad range of hosts (e.g. Galli-Valerio, 1923, 1935, 1940; Bouvier et al, 1952 et seq). Also routine diagnosis in veterinary laboratories tend to leave identification at the generic level.

The commonly occurring parasites of roe found here—*O. leptospicularis*, *S. spiculoptera*, *T. axei*, *T. capricola*, *N. filicollis*, *T. ovis*, *C. ovis*, and *D. viviparus*—are those frequently recorded from roe deer elsewhere in Europe (e.g. by Jansen, 1958; Dunn, 1965; Delić et al, 1965; and Dróżdż, 1966). Taking the abomasal helminths, Table VI below makes some comparisons with the figures from two of these studies.

Dunn (1965) in comparing his figures with those of Jansen (1958) noted the difference in emphasis of certain species but regarded the species complex in roes from the two areas as similar. This comment can be extended to include the results of the present work. A point of interest is that neither Dunn (1965) nor

Nilsson (1971) found *T. capricola* from the abomasum of the hosts they examined, although they made frequent records of this species from the small intestine. The latter organ is regarded as the site of predilection for this species, but results here show that infection is frequently common in both organs.

In this and the other works cited above, *S. kolchida* and *R. mathevossiani* (both frequently recorded deer parasites) were often found in roe but, as is the case in other deer, they were usually found in small numbers. This appears to be a parallel situation to that in sheep where *O. trifurcata* usually occurs with, and subordinate to, *O. circumcincta*. Such cases should not be confused with those in which the worm, when infecting other than the favoured host species, is found frequently in small numbers. An example of this is the appearance of *O. ostertagi* in deer (including those of the present study) in relatively small numbers—this species normally favours cattle. *Spiculopteragia asymmetrica* which normally favours red deer and fallow deer, has been recorded in small numbers from roe by both Jansen (1958) and Dunn (1965). The absence of this species from hosts examined here may be explained by the fact that there is almost a complete absence of fallow deer in Switzerland and red deer, although common in some parts of this country, are only rarely seen in Canton Berne.

The sex ratio of members of the tribe Ostertagiea (in Table II) is similar to that recorded by Dunn (1965) for the November-December period (the present collections were made in the last week of October). Dunn's ratio for this group was 1 : 1.70 compared with a ratio here of 1 : 1.76. His ratio for *N. filicollis* (1 : 0.93) is also similar to that recorded here for this species, but his ratio for *T. axei* (1 : 0.76) is quite different.

The figures for total worm burden given by Dunn (879 for young, 894 for older hosts) are of a similar order to the mean figure for Emmental deer. The figures from Schultze-Rhonhof (1968) for *Trichuris* (0-110), *C. ovina* (0-256), and *D. viviparus* (0-120) for German roes are also comparable to those recorded here. Nilsson (1971) gives population figures for individual species, but most of these are far higher than those recorded here (e.g. *T. axei* up to 10 400; *T. capricola* up to 28 400; and *N. filicollis* up to 5 600), however his material was drawn almost exclusively from animals that were found dead in the field (mostly from starvation), and it is likely that such animals would carry higher worm burdens. The present material (from the Emmental) was drawn from healthy animals shot on hunting expeditions. It is clear that, in terms of worm numbers, the abomasum is usually the most heavily infected organ.

Parasites appeared to have a limited influence on the health of roes examined. As can be seen from Tables II and IV above, the population levels of the worms are generally below those commonly regarded as pathogenic. Only *D. viviparus* and to a lesser degree *T. ovis* could be implicated as pathogens and even in these cases the outward signs were not indicative of serious or persistent disease. It is not surprising that the figures in Table V show an increase in infection incidence among sick animals, but there was no evidence to suggest that parasites were responsible for the sickness or death of the host. Parasites are therefore probably less of a factor in roe deer deaths in Switzerland than is commonly believed. Although two-thirds of the known parasite species from Swiss roe deer are found in domestic animals, indications are that the roe can be regarded as having limited importance as a reservoir of domestic stock parasites. Several of the species common to the two groups of hosts do not have a major role in stock disease and those parasites carried by the roe that are of some importance to domestic stock appear to be carried in relatively small numbers and are therefore unlikely to be of great significance. It is clear however that roe deer in this country have a very close association with domestic animals and the former may, therefore, have a future role in measures to eradicate some parasite species.

The quantitative findings of the present study (particularly those from the Emmental deer) are to some extent only valid for the season of the year in which the research was undertaken. Although, qualitatively, the parasite fauna of the hosts is likely to remain more or less consistent throughout the year, the worm population figures may well undergo seasonal changes, as recorded by Dunn (1965) in the British roe deer and Hübner (1938) in German roes. Both authors recorded a noticeable rise in worm counts in spring and another smaller, but still perceptible, rise in autumn or late autumn. For example, Hübner's work indicates that the present study was undertaken just after the autumn high point of the *C. ovina* season when a sudden drop in numbers of this species takes place. This would explain why numbers of *C. ovina* in some hosts studied here were quite high, while in others very few worms were found but there was evidence of a recent and heavier infection.

The finding of a high frequency of *D. viviparus* in the young deer is consistent with the findings of Hörning and Wandeler (1968) who showed that the young in their first autumn showed a higher incidence of *D. viviparus* infection than any other age group. The evidence, from the diagnostic records, that *T. ovis* favours young hosts, confirms a previous finding of one of the authors (Andrews, unpublished notes) who found when studying wild ruminants in New Zealand, that this nematode was found in greater numbers and more frequently in young animals. The finding from the Institute's records, that there is a considerably lower rate of infection in hosts of up to three months of age, is to be expected as animals of this age are still feeding from the mother with only exploratory feeding from the herbage where infection can be encountered.

A useful next step in the further evaluation of the role of parasites in Swiss roe deer would be to examine hosts taken in other seasons of the year—particularly during the spring months when populations of most worms would quite likely be at their maximum.

Summary

From 15 Emmental roe deer, 21 helminth parasite species were recorded, six of which were new records from roe deer in Switzerland. The helminth fauna, in general, appears to be similar to that recorded from this host in other European countries. The evidence available suggests that these parasites have a limited role in host sickness and mortality and the hosts do not, at this stage, appear to be important reservoirs for helminths of domestic stock. There is evidence to suggest that sick (from some cause other than parasites) hosts have a greater incidence of infection by some parasite species. The lungworms (*D. viviparus* and *C. capreoli*) and *T. ovis* have a greater incidence of infection in young animals.

ACKNOWLEDGEMENTS

Thanks are due to Professor H. Fey, Director of the Veterinary Bacteriology and Parasitology Institute, and Professor W. Huber, Director of the Natural History Museum, Berne, for their cooperation in the arrangement of research facilities; to the technical staff of the Parasitology Department for their assistance in the laboratory; and to the hunters of the Hunting and Wildlife Conservation Society of the district of Trachselwald, who willingly provided us with material. The support of the Federal Scholarships Commission of Switzerland and the Internal Research Committee of the Victoria University of Wellington is also gratefully acknowledged.

LITERATURE CITED

Asadov, S. M. 1954. Contribution to the study of the helminth fauna of *Capreolus capreolus* L. in Azerbaidzhan. In Russian. *Izvestija Akad. Nauk Azerb. SSR* 9: 33-35.

Asadov, S. M. 1960. The helminth fauna of the ruminants of the USSR and its ecologic-geographical analysis. In Russian. Publishing House of the Academy of Sciences of the Azerbaidzhanian SSR, Baku, 511 pp.

Bornand, M. 1939. Observations sur quelques maladies parasitaires du gibier en 1937 et en 1938. *Schweiz. Arch. Tierheilkde.* 81: 65-70.

Bouvier, G. 1946. Observations sur les maladies du gibier, quelques animaux sauvages et des poissons, (1942-1945). *Schweiz. Arch. Tierheilkde.* 88: 268-274.

Bouvier, G. 1947. Observations sur les maladies du Gibier en 1946. *Schweiz. Arch. Tierheilkde.* 89: 240-254.

Bouvier, G. 1963. Observations sur les maladies du gibier et des animaux sauvages faites en 1961 et 1962. *Schweiz. Arch. Tierheilkde.* 105: 337-345.

Bouvier, G., H. Burgisser and P. A. Schneider. 1952. Observations sur les maladies du gibier, des oiseaux et des poissons en 1951. *Schweiz. Arch. Tierheilkde.* 94: 476-479.

Bouvier, G., H. Burgisser and P. A. Schneider. 1955. Observations sur les maladies du gibier, des oiseaux et des poissons faites en 1953 et 1954. *Schweiz. Arch. Tierheilkde.* 97: 318-325.

Bouvier, G., H. Burgisser and P. A. Schneider. 1957. Observations sur les maladies du gibier, des oiseaux et des poissons faites en 1955 et 1956. *Schweiz. Arch. Tierheilkde.* 99: 461-477.

Bouvier, G., H. Burgisser and P. A. Schneider. 1958. *Les Maladies des Ruminants Sauvages de la Suisse.* Lausanne, 132 pp.

Bouvier, G., H. Burgisser and R. Schweizer. 1951. Observations sur les maladies du gibier et des poissons en 1949 et 1950. *Schweiz. Arch. Tierheilkde.* 93: 275-281.

Delić, S., J. Levi and J. Rukavina. 1965. Parasitofauna of does in some regions of Bosnia. *Veterinaria* (Sarajevo), 14: 189-195.

Drózdz, J. 1966. Studies on helminths and helminthiases in Cervidae. II. The helminth fauna in Cervidae in Poland. *Acta parasitol. polon.* 14: 2-13.

Dunn, A. M. 1965. The gastro-intestinal helminths of wild ruminants in Britain. I. Roe deer, *Capreolus capreolus capreolus*. *Parasitology*, 55: 739-745.

Galli-Valerio, B. 1923. Parasitologische Untersuchungen und Beiträge zur parasitologischen Technik. *Zbl. Bakt. I. Abt., Orig.* 91: 120-125.

Galli-Valerio, B. 1935. Parasitologische Untersuchungen und parasitologische Technik. *Zbl. Bakt. I. Abt., Orig.* 135: 318-327.

Galli-Valerio, B. 1940. Notes de parasitologie et de technique parasitologique. *Schweiz. Arch. Tierheilkde.* 82: 279-392.

Grieder, H. 1934. Beobachtungen über Wildkrankheiten. *Schweiz. Arch. Tierheilkde.* 91: 391-396.

Grieder, H. 1938*a*. Forensiche Auswirkungen einer hochgradigen Endoparasiteninvasion in einem Rehbestande. *Schweiz. Arch. Tierheilkde.* 80: 23—29.

Grieder, H. 1938*b*. Filaridae, Filariosis und Mikrofilariosis bei verschiedenen Säugetieren. *Schweiz. Arch. Tierheilkde.* 80: 485-490.

Hörning, B., and A. Wandeler. 1968. Der Lungenwurmbefall von Reh und Gemse in einigen Gebieten der Schweiz. *Rev. suisse Zool.* 75: 597-608.

Hübner, F. 1938. *Die Magenwurmseuche des Rehwildes.* Paul Parey, Berlin, 22 pp.

Jansen, J. 1958. Lebmaagtrichostrongyliden bij Nederlandse herten. *Thesis*, University of Utrecht, 100 pp.

Kotrly, A. 1964. Ekologie cizopasníků spárkaté zvěře čeledi Cervidae a Bovidae v ČSSR. *Pr. vyzk. Ust. Lesn.* 29: 5-47.

Kreis, H. 1952. Helminthologische Untersuchungen in schweizerischen Tierpärken und bei Haustieren. *Schweiz. Arch. Tierheilkde.* 94: 499-583.

Kreis, H. 1962. Neue helminthologische Untersuchungen in schweizerischen Tierpärken, bei Haustieren und bei Tieren des Schweizerischen Nationalparkes. *Schweiz. Arch. Tierheilkde.* 104: 94-115 and 1969-194.

Kutzer, E. and H. K. Hinaidy. 1969. Die Parasiten der wildlebenden Wiederkäuer Österreichs. *Zsch. Parasitenkde.* 32: 354-368.

NILSSON, O. 1971. The interrelationship of endo-parasites in wild cervids (*Capreolus capreolus* L. and *Alces alces* L.) and domestic ruminants in Sweden. *Acta vet. scand.* 12: 36-38.

SCHULTZE-RHONHOF, J. 1968. Untersuchungen über den Helminthenbefall des Rehwildes und der jahrezeitlichen Schwankungen in der Wurmei- und Larvenausscheidung. *Thesis*, Ludwig-Maximilians Universität, München, 59 pp.

SCHWEIZER, R. 1949. Beobachtungen über Wildkrankheiten. *Schweiz. Arch. Tierheilkde.* 91: 391-396.

SHOHO, C. 1959. Die Setarien vom schweizerischen Reh, *Capreolus capreolus. Rev. suisse Zool.* 66: 233-258.

Adresses des auteurs :

J.R.H. Andrews,
Zoology Department
Victoria University of Wellington,
Wellington, New Zealand.

B. Hörning,
Institut für Tierpathologie,
Länggass-Strasse 122, CH-3001 Bern.

A. Wandeler,
Vet.-Bakteriolog. Institut,
Länggass-Strasse 122, CH-3001 Bern.

TABLE I

Summary of records from roe deer in Switzerland

° *Strongyloides papillosus :* Kreis, 1952, 1962
Haemonchus contortus : Grieder, 1934, 1938*a*; Kreis, 1952, 1962; Bouvier et al, 1955, 1958
Ostertagia ostertagi : Kreis, 1962
Ostertagia circumcincta : Kreis, 1952, 1962

° *Ostertagia* spp.: Kreis, 1952, 1962
Spiculopteragia spiculoptera : Kreis, 1962
Trichostrongylus axei : Kreis, 1962
Trichostrongylus colubriformis : Kreis, 1952, 1962

° *Trichostrongylus* spp.: Kreis, 1952
Cooperia spp.: Kreis, 1952, 1962
Nematodirus filicollis : Schweizer, 1949; Kreis, 1952, 1962; Bouvier et al, 1955, 1958
Bunostomum trigonocephalum : Galli-Valerio, 1923; Kreis, 1952, 1962; Bouvier et al, 1955, 1958

° *Capillaria longipes :* Kreis, 1952, 1962
Oesophagostomum venulosum : Schweizer, 1949; Kreis, 1952
Chabertia ovina : Grieder, 1934; Galli-Valerio, 1940; Bouvier, 1947; Schweizer, 1949; Kreis, 1952, 1962; Bouvier et al, 1955, 1958
Trichuris ovis : Galli-Valerio, 1935; Grieder, 1938*a*; Kreis, 1952, 1962; Bouvier et al, 1958

* *Setaria "labiato-papillosa" :* Grieder, 1938*b*; Kreis, 1952; Bouvier et al, 1952
Setaria tundra capreoli : Shoho, 1959

° *Muellerius capillaris:* Kreis, 1952
Dictyocaulus viviparus: Grieder, 1934, 1938*a*; Bouvier, 1946, 1947; Kreis, 1952, 1962; Bouvier et al, 1955, 1958; Hörning and Wandeler, 1968
Protostrongylus rufescens: Galli-Valerio, 1935; Bornand, 1939
Capreocaulus capreoli: Galli-Valerio, 1940; Kreis, 1952, 1962; Bouvier et al, 1955, 1958; Hörning and Wandeler, 1968

° *Fasciola hepatica:* Kreis, 1952
Dicrocoelium lanceolatum: Galli-Valerio, 1935; Bornand, 1939; Bouvier et al, 1951, 1952, 1958
Cysticercus tenuicollis: Grieder, 1938*a*; Bouvier, 1947
Cysticercus cervi: Bouvier et al, 1957
Moniezia expansa: Grieder, 1938*a*; Schweizer, 1949; Bouvier et al, 1958
Moniezia benedeni: Galli-Valerio, 1940
Coenurus cerebralis: Bouvier, 1963

° Identified from eggs or larvae only.

* Most of this material, when examined by Shoho (1959), was placed by him in *S. tundra capreoli.*

TABLE II

Parasites recorded

	Location	Total No. worms	Mean No. worms/host	Range: Total worm pop.	No. infect. hosts (of 15 examined)	ratio
SPECIES						
Ostertagia ostertagi	a	6535	436	11-1560	7	1 : 1.7
† *O. leptospicularis*	a				15	
† *Skriabinagia kolchida*	a				15	
Spiculopteragia spiculoptera . .	a				15	
† *Rinadia mathevossiani*	a				8	
Trichostrongylus axei	a	2031	135	0-805	13	1 : 1.9
† *T. capricola*	as	3640	243	2-897	15	1 : 1.0
T. colubriformis	s	1	1	0-1	1	—
† *T. longispicularis*	a	1	1	0-1	1	—
Nematodirus filicollis	as	669	45	0-247	14	1 : 0.78
Nematodirus larvae	s	58	4	0-16	9	—
† *Cooperia punctata*	s	28	2	0-22	3	1 : 0.56
Bunostomum trigonocephalum . .	s	1	1	0-1	1	—
° *Capillaria longipes*	s	6	1	0-6	1	—
Trichuris ovis	c	166	11	0-44	15	1 : 82.0
Chabertia ovina	li	1075	72	0-491	11	1 : 1.14
Dictyocaulus viviparus	lu	203	14	0-96	7	1 : 3.5
Capreocaulus capreoli	lu	(larval stages only)			1	—
° *Fasciola hepatica*	l	(recovered in histological sect.)			2	—
Dicrocoelium lanceolatum . . .	s	18	1	0-10	4	—
Moniezia expansa	s	5	1	0-2	4	—
* Cestode: Fam. Anoplocephalidae	s	1	1	—	1	—
Cysticercus tenuicollis	m	2	1	0-1	2	—

---

† New record for roe deer from Switzerland.

° Previously identified from Swiss roe deer, but from eggs only.

* The scolex was missing and a positive identification was not possible. It is quite likely *M. expansa.*

Sites of infection: a—abomasum; s—small intestine; c—caecum; li—large intestine; l—liver; lu—lungs; m—mesentery.

TABLE III

Proportions of species in those organs where two or more species were found.

	Mean (%)	Range (%)
Abomasum:		
O. ostertagi	0.81	0-6.15
O. leptospicularis	35.45	5.22-61.5
S. kolchida	10.44	0.40-22.4
R. mathevossiani	1.28	0-6.15
T. axei	20.18	0-93.10
T. capricola	8.69	0-56.80
N. filicollis	0.35	0-2.06
T. longispicularis	0.08	0-0.13
† Small intestine:		
T. capricola	78.49	0-94.00
T. colubriformis	0.03	0-0.24
N. filicollis	20.39	0-94.20
C. punctata	0.90	0-56.45
B. trigonocephalum	0.03	0-14.30
C. longipes	0.19	0-1.47
Cestode Fam. Anoplocephalidae (including *M. expansa*)	0.19	0-2.62
Caecum/Large intestine:		
T. ovis	43.56	2.58-1000
C. ovina	56.44	0-98.09

---

† *D. lanceolatum* not included—site not normal.

TABLE IV

Means and ranges of total worm populations according to organ

	Mean	Range
Abomasum	654.93	11-2276
Small intestine	206.66	0-906
Caecum/Large intestine	82.73	2-504
Lung	13.53	0-96
Total	958.40	166-2973

TABLE V

Percentage incidence of infection of roe according to age and condition of health *

		3 months-1 year old: (% infected)	over 1 year old: (% infected)
Ostertagia spp.	H	17.5	17.5
	S	43.0	33.3
Trichuris ovis.	H	43.0	18.5
	S	78.3	37.4
Chabertia ovina.	H	43.1	64.0
	S	86.5	58.7
Dictyocaulus viviparus . . .	H	54.0	13.6
	S	68.5	41.1
Capreocaulus capreoli . . .	H	65.5	15.9
	S	66.7	35.6

H = healthy S = sick

---

* Compiled from the diagnostic records of the Vet.-Bacteriology and Parasitology Institute.

TABLE VI

Comparisons of infection by helminths in the abomasum of roe deer

	Jansen, 1958: (68 examined) %	Dunn, 1965: (61 examined) %	Present Study: (15 examined) %
O. leptospicularis	21.76 (96)	40.30 (91.8)	35.5 (100)
O. ostertagi	2.37 (22)	† (1.6)	0.8 (47)
S. spiculoptera	45.53 (93)	32.00 (88.5)	22.7 (100)
S. asymmetrica	0.13 (4)	4.80 (19.7)	—
* *S. kolchida*	7.68 (91)	19.70 (80.3)	10.4 (100)
R. mathevossiani	4.11 (71)	1.10 (24.6)	1.3 (53)
T. axei	16.05 (55)	1.60 (45.9)	20.2 (87)
T. capricola	1.51 (31)	—	8.7 (53)

The figures represent percentage proportion of worms in the abomasum and (in brackets) the percentage incidence of infection.

---

† less than 1%

* *S. kolchida* = *Grosspiculagia lasensis* (Asadov, 1953).